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SUBJECT: PANTHER 300M MAXIMUM PERMISSIBLE EMISSION (MPE) CALCULATIONS

To: W. Graff B. Clavier
Cc: D. Foust B. Hays K. Markey S. Miller T. Camper B. Speidel S. Frackleton

Panther 300M MPE calculations are based on meeting the MPE RF exposure limits set by the FCC for General Population/Uncontrolled Exposure, as specified in 47 CFR § 1.1310. The MPE Radius is constant for any VHF frequency, and is at a worst case maximum length at the minimum UHF frequency.

General Population/Uncontrolled Exposure for the VHF band (136-174 MHz): the limit is 0.2 mW/cm^2; for the UHF band (450-512 MHz), the limit is f/1500 mW/cm^2 where f is in MHz.

The MPE Radius is the minimum distance needed from the antenna to not exceed the exposure limits. The MPE Radii calculations are based on:

MPE Radius = SQR [(P_{in} x 1.64 x $10^{GdBd/10}$ /(4 x Π x MPE)]

where MPE Radius is in cm, P_{in} in mW, & MPE is in mW/cm^2. GdBd is the maximum gain of the antenna above that of a 1/2 wave dipole (1/4 wave whip antenna).

Example #1: P_{in} = 43.8 W; the antenna = 1/4 whip antenna, Ftx = 160 MHz,

MPE Radiis = SQR [(43,800 x 1.64 x 10^0 / (4 x Π x 0.2)] = 169.06 cm = 66.56 inches.

Example #2: P_{in} = 43.8 W; the antenna = 3 dBd gain antenna, Ftx = 450 MHz,

MPE Radius = SQR [(43,800 x 1.64 x $10^{0.3}$/ (4 x Π x 450/1500)] = 194.98 cm = 76.76 inches.

NOTE: The calculations on the next three pages are based on the following criterion:

1) 40 Watt RATED POWER MPE Radii calculations are based on the actual 43.8 W measured value.
2) 30 Watt RATED POWER MPE Radii calculations are based on the actual 30.0 W measured value.
3) 20 Watt RATED POWER MPE Radii calculations are based on the actual 21.9 W measured value.

Kind regards, Michael Fulk

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Panther 300M VHF/UHF Operator's Manual Text, Rev PA4 09/18/00
Michael S. Fulk

[The following text will be included in the Operator's Manual, Section 1 "Safety Information" & in the Installation Manual:]

RADIO OPERATOR WARNING

Do not transmit with this radio and antenna when persons are within the **MPE Radius*** of the antenna [see "Determining MPE Radius" in this section], unless such persons (such as the driver or radio operator) are isolated from the antenna field by a grounded metallic barrier (such as the user's vehicle rooftop). **MPE Radius** is the minimum distance from the antenna axis that persons should maintain in order to avoid RF exposure higher than the allowable **MPE level set by the FCC** for General Population/Uncontrolled, as specified in 47 CFR § 1.1310.

FAILURE TO OBSERVE THESE LIMITS MAY ALLOW THOSE WITHIN THE MPE RADIUS TO EXPERIENCE RF RADIATION ABSORPTION WHICH EXCEEDS THE FCC MAXIMUM PERMISSIBLE EXPOSURE (MPE) LIMIT FOR GENERAL POPULATION/UNCONTROLLED EXPOSURE.

Determining MPE Radius

In the tables following, MPE Radii are listed for ranges of power within which this radio is intended to operate (20 - 40 Watts) and for antennas having gains of 0 - 6 dBd (1/4 **λ,** quarter-wave monopole = 0 dBd).

Use the following procedure to determine the MPE radius for a specific application:

1. Choose the VHF or UHF table that meets the FCC limits for General Population/Uncontrolled Exposure.

2. Choose the row containing the power level going into the antenna.

3. Read the MPE Radius in the position intersecting the corresponding antenna gain. **(NOTE:** For power or gain ratings not appearing in the tables, select the next higher listed number in each case.

If the power level is not known (set by personality programming), assume the maximum of 40 Watts. If the gain rating of the antenna is not known, consult the antenna provider. For antennas with higher gains than those listed in the tables, consult the radio supplier.

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MPE Radii for General Population/Uncontrolled Exposure: VHF Band (136 - 174 MHz[1])

Power[3]	Power[4]	dBd Antenna Gain[5]													
(Watts)	(Watts)	0		1		2		3		4		5		6	
⇩		Cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in
20	21.9	120	47	134	53	151	59	169	66	189	75	213	84	239	94
30	30.0[6]	140	55	157	62	176	69	198	78	222	87	248	98	279	110
40	43.8	169	67	190	75	213	84	239	94	268	105	301	118	337	133

MPE Radii for General Population/Uncontrolled Exposure: UHF Band (450 - 512 MHz[2])

Power[3]	Power[4]	dBd Antenna Gain[5]													
(Watts)	(Watts)	0		1		2		3		4		5		6	
⇩		Cm	in	Cm	in	cm	in	cm	in	cm	in	cm	in	cm	in
20	21.9	98	38	110	43	123	48	138	54	155	61	174	68	195	77
30	30.0[6]	114	45	128	50	144	57	161	64	181	71	203	80	228	90
40	43.8	138	54	155	61	174	68	195	77	219	86	245	97	275	108

Notes:
1. Numbers are calculated for any VHF frequency, since MPE radii is the same.
2. Numbers are calculated for 450 MHz, giving the largest (worst-case) MPE radii.
3. Rated RF Power delivered to antenna: radio output less cable and mismatch losses.
4. Actual measured RF Power delivered to antenna: radio output less cable and mismatch losses.
5. Gains are compared to an ideal, 1/4-wave monopole (1/2-wave dipole). Add 2.15 dB for comparison with an ideal isotropic source. (0 dBd = 2.15 dBi)
6. The 30 Watts Rated Power is set to an actual measured 30.0 Watts to meet the Industry Canada requirement of 30.0 Watts ± 1.0 dB.